

CLAIMS

1. A vertical heat treatment system comprising:
 - a heat treatment furnace;
 - a holder that is loaded and unloaded into and from the heat treatment furnace while the holder holds a plurality of process objects which are arranged at multiple level and spaced at vertical intervals;
 - a transfer mechanism that transfers process objects between the holder and a container adapted to hold a plurality of process objects at predetermined intervals, the transfer mechanism including a base adapted for vertical movement and turning movement, and a plurality of substrate holding devices, each adapted to support a process object, mounted to the base so as to be movable anteroposteriorly;
 - a target member to be placed at a target position, in the holder or the container, to which a process object is to be transferred;
 - a first sensor, attached to the base, that emits a light beam directed toward a direction in which the substrate support device moves, and detects the target member upon receipt of a reflected light of the light beam;
 - a second sensor, attached to two tip end portions of the substrate support device, that detects the target member upon interruption of a light beam traveling between the tip end portions by the target member; and
 - a control unit that deduces the target position based on detection signals of the first and second sensors and encoder values of drive systems of the transfer mechanism associated with the detection signals, and recognizes the target position thus deduced.
2. The vertical heat treatment system according to claim 1, wherein the target member includes:
 - a substrate part having an dimension substantially identical with that of the process object;

a first detection target part provided on a center portion of the substrate part to project therefrom, and having a circumference provided thereon with a reflective surface for reflecting the light beam emitted by the first sensor; and

one or two second detection target parts to be detected by the second sensor, wherein the second detection target is provided on the upper portion of the first detection target part if the second detection target numbers one, and the second detection target parts are provided on the substrate part and arranged symmetrically with respect to the first detection target part with the first detection target part being disposed between the second detection target parts if the second detection target numbers two.

3. The vertical heat treatment system according to claim 1 or 2, wherein the control unit is configured to perform, when the control unit deduces and recognizes the target position, the steps including:

a first step that moves the base vertically to detect a position where the detection signal of the first sensor is reversed, and deduces a center of the target member with respect to a vertical direction based on an encoder value of the drive system relating to the vertical movement of the base obtained at the position where the detection signal of the first sensor is reversed;

a second step that turns the base about an vertical axis to detect a position where the detection signal of the first sensor is reversed, and deduces a center of the target member with respect to a turning direction based on an encoder value of the drive system relating to the turning movement of the base obtained at the position where the detection signal of the first sensor is reversed; and

a third step that moves the substrate support device to detect a position where the detection signal of the second sensor is reversed, and deduces a center of the target member with respect to an anteroposterior direction based on an

encoder value of the drive system relating to an anteroposterior movement of the substrate support device obtained at the position where the detection signal of the second sensor is reversed.

4. The vertical heat treatment system according to claim 1, wherein the substrate support devices are provided with gripping mechanisms adapted to hold process objects by gripping them from their front and rear ends.

5. The vertical heat treatment system according to claim 1, wherein the second sensor is arranged and adapted to detect conditions of process objects held in the holder at multiple levels by scanning the process objects along a vertical direction in which the process objects are arrayed.

6. A method of teaching a transfer mechanism of a vertical heat treatment system, which includes: a heat treatment furnace; a holder that is loaded and unloaded into and from the heat treatment furnace while the holder holds a plurality of process objects which are arranged at multiple level and spaced at vertical intervals; the transfer mechanism that transfers process objects between the holder and a container adapted to hold a plurality of process objects at predetermined intervals, the transfer mechanism including a base adapted for vertical movement and turning movement, and a plurality of substrate holding devices, each adapted to support a process object, mounted to the base so as to be movable anteroposteriorly, said method comprising the steps of:

placing a target member at a target position, in the holder or the container, to which a process object is to be transferred;

providing, on the base, a first sensor that emits a light beam directed toward a direction in which the substrate support device moves, and detects the target member upon receipt of a reflected light of the light beam, and providing a second sensor,

on two tip end portions of the substrate support device, that detects the target member upon interruption of a light beam traveling between the tip end portions by the target member;

recognizing the target position by performing: a first step that moves the base vertically to detect a position where the detection signal of the first sensor is reversed, and deduces a center of the target member with respect to a vertical direction based on an encoder value of the drive system relating to the vertical movement of the base obtained at the position where the detection signal of the first sensor is reversed; a second step that turns the base about an vertical axis to detect a position where the detection signal of the first sensor is reversed, and deduces a center of the target member with respect to a turning direction based on an encoder value of the drive system relating to the turning movement of the base obtained at the position where the detection signal of the first sensor is reversed; and a third step that moves the substrate support device to detect a position where the detection signal of the second sensor is reversed, and deduces a center of the target member with respect to an anteroposterior direction based on an encoder value of the drive system relating to an anteroposterior movement of the substrate support device obtained at the position where the detection signal of the second sensor is reversed.